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Westinghouse Electric Corporation

Air Arm Division

Friendship International Airport
Box 746, Baltimore 3, Md.
Telephone: 761-1000

23 March 1965
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Advanced Plans & Programs Office (ASZ-5)
Deputy for Systems Management
Hq., Aeronautical Systems Division
Wright-Patterson Air Force Base, Ohio

Subject: Contract AF33(600)40280
Westinghouse Reference: BYD-45196

Enclosure (1): Three (3) copies Progress Report June 1 through June 30, 1964

Enclosure (2): Three (3) copies Progress Report September 1, 1964 through January 31, 1965

Gentlemen:

In accordance with the subject contract, we are enclosing the progress reports for the periods indicated.

Very truly yours,

WESTINGHOUSE ELECTRIC CORPORATION

[redacted] STAT

Marketing Specialist
Marketing Department

RWE:sb

cc: [redacted] STAT
(With One (1) Copy Enclosure (1)

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PROGRESS REPORT

FOR

PERIOD OF SEPTEMBER 1, 1964 TO JANUARY 31, 1965

CONTRACT NUMBER AF33(600)40280

BY

WESTINGHOUSE ELECTRIC CORPORATION

AEROSPACE DIVISION

BOX 746, BALTIMORE 3, MARYLAND 21203

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A F-101 FLIGHT TEST

The 300 hour periodic inspection of the F-101 aircraft was completed with the functional test flight on 9 September 1964. The first radar flight followed on 14 September. A summary of the flight program is given in Table I.

Radar flights flown in this period from September 1964 through January 1965 are summarized in Appendix A. A defective aircraft cooling system prevented flights between 17 December and 28 December.

Modifications and Ground Tests

Receiver

Three receiver modifications have been performed and tested. First, the Tunnel Diode Pre-amplifier was replaced with a parametric amplifier built by Micro-Mega, repeating a test started on flight 114 prior to the aircraft inspection. This amplifier has gain of 16 db and produced a system noise figure of 5.6 db, an improvement of 0.9 db over the Tunnel Diode Amplifier. After flight testing on 127, the TDA was re-installed.

Prior to flight 130, a second limiting IF amplifier was installed to allow cockpit variations in the signal level to the video amplifier without changing the limited signal to the DFT. This permits changing the signal return power at which limiting occurs. This second limiting IF has remained a part of the F-101 installation.

The third receiver modification consisted of replacing the Tunnel Diode pre-amplifier with the final configuration of the parametric amplifier, one designed and built by Westinghouse. Installing this component required constructing a 400 volt power supply,

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TABLE I

F-101 PROGRAM SUMMARY

September 1964 through January 1965

Flights Scheduled				51
Flights Accomplished				32
Aircraft			2	
Functional Test Flight		1		
Pilot's Proficiency		1		
Radar			30	
Productive Flights		24		
Productive Flights Prior to a Failure		4		
Film drive and diode switch failure	1			
Transmitter overload	1			
Transmitter failure	1			
Transmitter servo failure	1			
No Results		2		
Film drive failure	1			
Military Operations over target area	1			
Flights Cancelled				19
Weather			9	
Motion Compensation System			3 1/2	
Transmitter			1 1/2	
Transmitter Servo			1	
Aircraft Compass Problems			1	
Aircraft Oxygen Supply Inadequate			1	
Aircraft Turbine Failure			1	
Inspection Scheduling			1	

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fabricating and mounting bracketry, and modifying wave-guide runs.

This par-amp produced a system noise figure of 5.1 db, and is now installed and ready for flight test. Because of the improved noise figure and apparent stability of this unit, units of this type are planned for the two deliverable systems as well as the F-101.

Receiver tests performed on the F-101 system were reported in STM 164.

Transmitter

Flights 115 through 123 used a transmitter having a narrow pulse forming network in the CFA discharge circuit. Pulse width was 28 nanoseconds and average power 22.5 watts. The remainder of the flights used the original PFN, which produced 37 nanosecond pulse width at 29.5 watts. The narrow transmitted pulse generated by reducing TWT RF drive pulse width (as described in section E of this report) has not been flight tested.

Prior to flight 132, the thyratron was replaced in the CFA modulator and average power increased to 58 watts.

TWT and CFA pulse coincidence was lost on flights 120 and 121, caused by a defective tunnel diode in the transmitter servo. Checking to determine if temperature was a problem, a thermistor measured the highest temperature on the servo chassis in-flight to be 39°C, which is not excessive.

Doppler Frequency Tracker

Six flights were made off-shore from Charleston, South Carolina to Savannah, Georgia. For the last four of these flights, the DFT gate was moved from its normal 180 usec range to 235 usec to reduce the loss of DFT operation when the gate is over water.

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Motion Compensation

Tests on the motion compensation system were started on flight 117. In-flight the integrator output would not return to zero. This condition was corrected by changing tube and wire shield grounds and by adding decoupling to the power supplies.

In addition, a transient occurs when the accelerometer is connected in-flight to the integrator network, causing the network to accumulate an excessive charge. Investigations into this network charging are still underway.

During the course of these tests, an integrator of deliverable configuration (built by Minneapolis-Honeywell) was installed in the F-101. After correction of initial drift problems, satisfactory operation was obtained. System gain was checked by causing the aircraft to pitch sinusoidally approximately 0.3g and evaluating instrumentation data. Results were obtained on the film of flight 131 with the forced aircraft pitching both with and without motion compensation.

An incorrect accelerometer scale factor (volts per g) caused the gain at the integrator input to be set too high on flight 136.

Recorder

The film speed inverter and CRT filament power supply have been installed external to the recorder to minimize 400 cps pick-up.

Following flight 126, a general tightening of the recorder was performed, which improved the reliability of film transport and vibration striping on the film. This procedure is required to be repeated periodically.

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Several different film emulsions of the Eastman 5401 film have been used during this 30 flight period. Prior to the use of a new emulsion, sensitometric measurements and CRT bias-density curves are plotted to determine optimum CRT operating voltages. This procedure along with a bias only film sample on each pre-flight test has enabled determination of CRT performance for each flight. A defective CRT bias pot was located through these tests.

Recorder 007 was modified to the final altitude (4 kc sweep rate) configuration and tested on flights 142, 143, and 144 to simulate final altitude results. Recorder operation was satisfactory.

A study of CRT bias tests resulted in adjusting the CRT closer to cut-off for all flights after 133. This theoretically

(1) operates the CRT in a more linear region of the video-transmission curve, causing fewer images

(2) gives greater contrast for small targets

(3) gives brighter image on the correlation, or allows operation of the correlator at a faster speed.

Results on the correlated film are significantly improved with the lower bias voltage. Nominal density on the primary film is now averaging about 0.3.

Poor correlation of flights 128 and 129 flown at the extreme lower limit of ground speed triggered ground tests of ground speed-film speed tracking. Tracking was found to be 3 per cent in error at the lower limit of 750 knots ground speed. After adjustment, less than .3 per cent error in film speed was found over the full range of 780 to 900 knots ground speed.

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The field flattener in recorder 007 for the far range sector cracked. Since useful video occurs only on far range in 4 kc sweep rate operation from 45,000 feet altitude, the recorder wiring was modified to interchange the near and far range traces on the CRT and satisfactory operation was obtained.

Dual Altitude Operation

Flight 132, planned for 45,000 feet altitude over Norfolk, was aborted due to military operations taking place in the flight area. Following this flight, a switch was installed in the cockpit to permit the radar operator to select DFT gate position and recorder CRT blanking for either high or low altitude operation. This flight has been used twice to date to fly both high and low altitude flights the same day.

<u>In-Flight Tests</u>

Repeated runs over the same target area with various second IF amplifier bias levels were made to determine the extent of images caused by IF limiting. Flight path was not consistent enough to check data; the series will be repeated.

Several flights were flown to test the range boost circuitry in both the 8 kc and 4 kc sweep rate configurations, as noted in Appendix A.

Four flights were made over the Philadelphia area to show results under simulated altitude conditions. A comparison of the results of flights 137 and the first run of flight 138 showed the simulation to be logical when extended to 90,000 feet, in flights 142 and 143.

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Flight No.	Altitude Flight	Simulated	Recorder Sweep Rate	RF Attenuation
138 Run 1	22,000	45,000	4 kc	10 db
137	45,000	45,000	4 kc	0 db
142, 143	45,000	90,000	8 kc	10 db

<u>Instrumentation</u>

The CEC oscillograph was removed from the aircraft in preparation for installing a KA-45 aerial camera in that location. Some of the signals formerly recorded on the CEC were added to the magnetic tape recording. The signals now recorded during each flight are:

Variable Frequency Oscillator Potentiometer Position

Antenna Accelerometer Output

Antenna Accelerometer Integrator Output

Antenna Position Error

Aircraft Pitch Angle

DFT Meter

Aircraft Drift Angle

Aircraft Roll Angle

Antenna Roll Table Position

Aircraft Ground Speed

Sine of Aircraft Heading

Recordings of the accelerations at the location of the aerial camera were taken.

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B PHASE II FLIGHT TEST

The unsolved problems listed in the August report have been corrected during this period. The errors in the INS output signals of drift and pitch were caused by loading of the INS output signal due to a wiring error in the aircraft magnetic recorder. A defective charging choke caused the transmitter overloading problem and was replaced. The erratic pulsed 120 mc from the frequency generator was due to a malfunction in the crystal gate driver.

Because of the lull in the Phase II activity, the following was returned to Baltimore in October to increase the assistance to the F-101 Flight Test Program and provide a back-up system:

(1) three of the four field engineers

(2) radar system 002, not including the antenna and single axis platform

(3) Radar Test Set

(4) Film Evaluator

(5) a few pieces of standard test equipment.

The second radar system, test set and the test equipment were set up in a new laboratory in the hangar, adjacent to the F-101. Maintained in a ready status, this system has been able to supply replacement assemblies for the F-101 system. In addition it has been used for check-out of modified and repaired sub-assemblies. Special system tests have been performed on system 002, such as phase-shift measurement of the receiving chain and modification of the recorder to the 4 kc sweep configuration.

Since return of the one system, activity on system 003 at the Phase II testing site has been limited to the installation of modifications on the inverter, torque motor, and focus power supply.

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A pressure test of the antenna indicated leakage to be about the same as it was when shipped a year ago.

A fourth field engineer, normally located at the Phase II site, returned to Baltimore for the month of December to assist in the correlator set-up and become more familiar with the modifications and testing procedures.

Minor modifications to all three systems have been progressing satisfactorily. Status is as follows:

Modification	Systems		Spares	
	Complete	In Work	Complete	In Work
Video Amp, Increased Bandwidth	2	1	1	0
Control Panel, Second Failure Determination	3	0	1	0
Frequency Generator, Temperature Stability, etc.	3	0	1	0
Frequency Generator, Oscillator	1	2	0	2
Transmitter, TWT Filament Supply	2	1	N/A	
Range Mark Selector	2	0	N/A	
Recorder, Inverter	3	0	N/A	
Recorder, Focus Power Supply	2	1	N/A	
Recorder, Torque Motor	3	0	N/A	
Recorder, Inverter Low Frequency Cut Out	3	0	N/A	

C DYNAMIC CORRELATOR

The dynamic correlator was transported from the Phase II testing area to Westinghouse. After arrival in Baltimore on November 23, the correlator was set up in a special laboratory space, with the first correlation processed on December 11. Operation of the equipment

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is by the same two Itek representatives as previously, with results that are equal to those attained previously.

Initial installation was with a makeshift exhaust blower. After installation of the proper blower and correction to the air conditioning in the room, a positive pressure in the room was attained. Dust studies under various conditions are being conducted to reduce the level as much as practical.

In January a Contact Printer was received as GFE and set up in the same laboratory as the correlator. Itek personnel will do most of the operation with this printer. Dupes of both the primary and correlated films can be exposed with this printer and developed with the Versamat provided by Westinghouse.

The consolidation of the radar and correlator work at Westinghouse has reduced the time to process flight films. However, interplay between the personnel of the two equipments is of much more significance. Several instances have occurred in the two months of operation where both radar and correlator problems have been engaged more productively with the close coordination now possible.

First example came with the processing of flight 136 film. First correlations were out of focus. However, a refocusing of the correlator produced good results and pointed out the excessive rate of change of the Variable Frequency Oscillator by the accelerometer integrator. Further checking isolated the difficulty to the wrong scale factor used for the accelerometer.

More recently, ground speed and imaging problems have been attacked more imaginatively through short recorrelations of certain flight or test data film. As both the radar and correlator engineers become more familiar with both equipments, even more

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effective use of the equipment can be made.

Advantages to the Radar Interpretation program of this correlator location are just as great.

D ENVIRONMENTAL TEST

The results of the temperature and altitude tests on the Frequency Generator were released in January as STM 161. No environmental tests in addition to this were performed during this period.

E MODIFICATION

Reduced Transmitter Pulse Width

Laboratory work on reduced transmitter pulse width was completed, using the rack breadboard transmitter returned from SFD. Transmitter results were encouraging, while receiver response tests revealed an inability to reproduce the narrowed pulse.

Changing the CFA pulse forming network from 30 to 20 nanoseconds did not narrow the output pulse because of stray capacitance of the charging choke and filament transformer. A 20 nanosecond output pulse was obtained by narrowing the TWT RF pulse driving the CFA to 20 nanoseconds, while pulsing the CFA with a normal anode pulse.

A CFA tube which delivered 146 watts average, 1.2 MW peak, at 30 nanoseconds, generated 90 watts average, 1.1 MW peak, when operated with a 20 nanosecond TWT pulse. Modulator efficiency dropped 26 per cent due to the increased effect of stray capacitance at the narrower pulse width.

Receiver response tests showed that the video output pulse is narrowed only slightly (approximately 3 per cent) for the 33 per cent pulse width reduction from 30 to 20 nanoseconds. At the same

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time, the amplitude decreases by 1.8 db. Thus, the present receiver prevents taking full advantage of the narrow pulse widths attainable with the transmitter.

Low Noise RF Pre-Amplifier

A wideband non-degenerate parametric amplifier was designed at Westinghouse and delivered for flight testing in the F-101. This parametric amplifier uses two matched varactor diodes in a novel circuit design to achieve improved temperature stability. The circuit configuration permits easy tuning of the idler resonant frequency, while eliminating the idler frequency from the signal arm. Stringent phase requirements between pump and signal frequencies are eliminated.

The delivered parametric amplifier, to be installed in the F-101, has the following characteristics:

Noise Figure	3.6 db
Gain	16 db
Bandwidth, 3 db	270 mc
1 db	200 mc
Flat	150 mc
Insertion Loss with no pump power	3 db
Pump Power	135 milliwatts
Pump Frequency	25.01 gigacycles
Beam Supply	-1039 volts at 28.5 milliamps
Reflector Supply	- 769 volts
Bias Supply	+ 0.545 volts

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System noise figure should be improved 1.0 to 1.5 db over that attained with the Tunnel Diode Amplifier. Further improvement (about 0.3 db) could be attained by using a low noise second stage in place of the present TWT. Parts are on order for the two deliverable pre-amplifiers.

Range Boost

Range boost extends the high frequency response of the video amplifier to compensate for the recorder high frequency response. Test films were generated using a single pulse in range of 20 to 40 nanoseconds duration. Four degrees of high frequency boost were run for each pulse width. Evaluation of the resulting test films was accomplished by scanning the recorded signal on the primary film with a micro-densitometer. Rise time of the recorded pulse was improved with range boost, but it was accompanied by ringing of the range pulse. Effective range resolution was not improved with any of the four amounts of boost.

The preceding ground tests were performed on recorders of both the 45,000 (8 kc sweep rate) and 90,000 (4 kc sweep rate) foot altitude configuration. Little difference was noted in the results of the two recorders as predicted theoretically. The work is complete except for the detailed evaluation of the 4 kc microdensitometer scans.

Data flights were made in the F-101 using the range boost of all four degrees with both the 8 kc and 4 kc recorders. No improvement of range resolution was noted on the secondary film. As a result of these tests, the two deliverable systems will not be modified for range boost.

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Increased Power Output

It has been recommended that the proposed modification of increasing power output by using improved cross field amplifier tubes be deleted. The expected improvement of 1.5 db in signal-to-noise ratio by this high power modification is about the same improvement attained through the change from a tunnel diode to a parametric pre-amplifier. The cost of the high power components alone would be more than the cost of the complete parametric amplifier installation. In addition, it is expected that normal tube development will make higher power CFA tubes available in the future.

F SYSTEM

Receiver Phase Shift

Phase linearity measurements were performed on the system receiver. Tests were performed using both the regular video amplifier (45 mc) and a narrow bandwidth version (30 mc). Results of the tests are shown on the graph of Figure 1.

Referring to the test equipment arrangement in Figure 2, the test signal source was an X-band klystron, whose output was fed to a TWT. This TWT was serrodyned to add 1 kc to the test signal, and its output passed through the receiver. The klystron test frequency was also passed through a phase shifter and double mixed in order to beat the video amplifier output frequencies down to a difference of 1 kc, containing the system phase information.

The serrodyning process produced some discontinuity pips at the 1 kc rate. These pips were reproduced at the output of the balanced mixer and served as phase change markers on the scope presentation.

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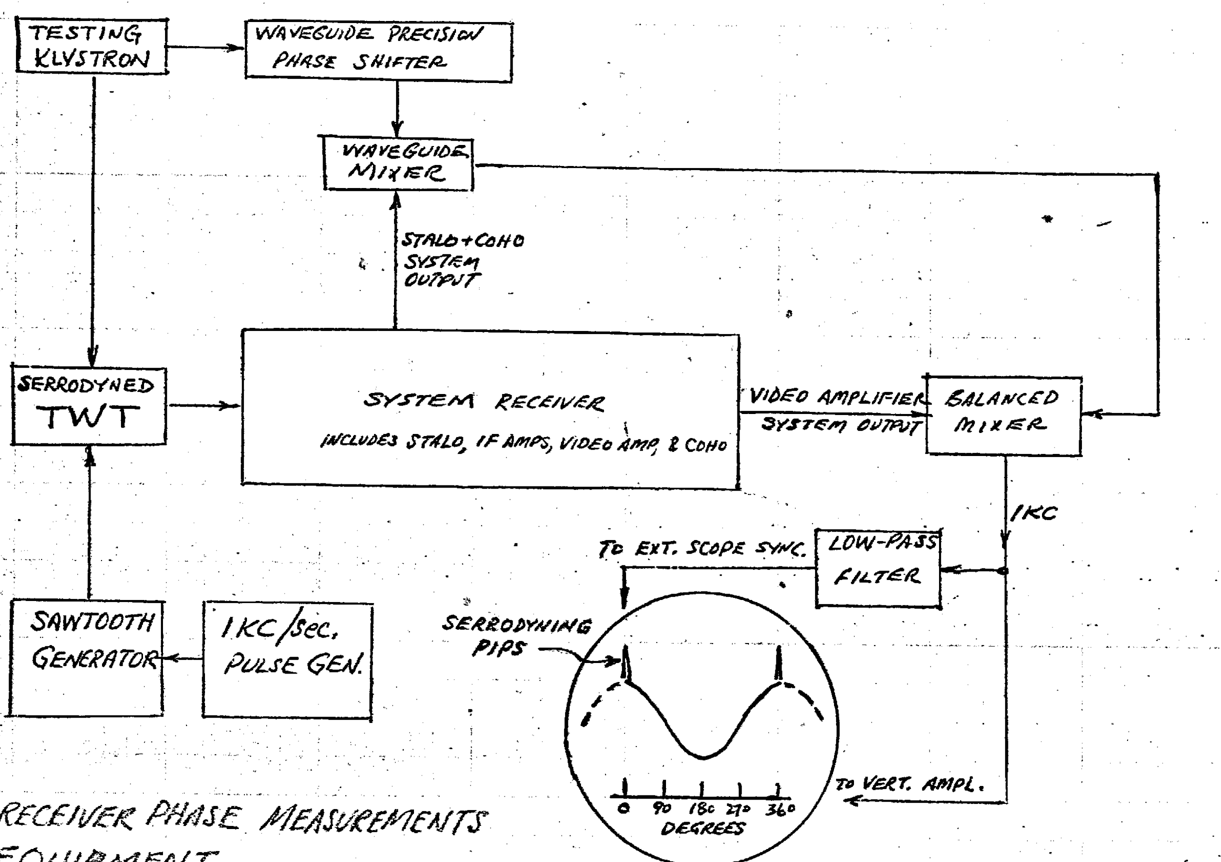

SOARD SYSTEM RECEIVER PHASE MEASUREMENTS
TEST EQUIPMENT
DIAGRAM

FIG-2

12-15-64

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A low pass filter removed the pips on the scope sync input, allowing the scope to sync on the sinewave only. Thus the pips were caused to move across the scope face in response to the system phase function.

Results with the wideband video are a smooth linear curve with a one cycle superimposed ripple. Origin of the ripple was not determined. Deviation in the phase shift of the receiver with wide-band video amplifier was within acceptable limits for video frequencies up to 20 mc.

Recorder

Analysis and some laboratory effort was performed to determine techniques of speed-up and linearization of the recorder sweep. Both are required to match the correlator characteristics and improve the output resolution. No changes are planned for this generation of equipment, since the improvement in resolution is rather small considering the cost involved.

Reliability

Failures have been reported through procedures established in February 1964 which allow calculation of mean times between failures for these systems. All improper system operations are classified as failures, including film jams, broken wires, and operator errors. Failures in which more than one component fails are considered only a single failure. The MTBF calculations are weighted to reflect actual ratio of standby to transmit time.

A summary of the failures and MTBF calculations is given below for the system in the F-101 and system 002, just recently returned to Baltimore. Operating time on system 003 in the field has been too low to make valid calculations.

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	F-101 System	System 002
Period	2/4/64 to 1/25/65	4/3/64 to 1/21/65
Operating Time, Standby	566.7	237.7
Transmit	140.5	32.1
Average Standby	48.2	24.4
Failures, Receiver	2	0
Recorder	6	12
Power Supply	2	5
Synchronizer	2	2
Transmitter	5	7
Nav Tie	0	2
Miscellaneous	0	5
Mean Time Between Failures	33.1	7.2

G ANTENNA

Although all tests on antenna pressure sealing have not been successful, the latest results are encouraging. Adding Ferric Acetel Acetonate to the Doryl adhesive caused a brittle bond with little adhesion. Aerosol OT was added to the adhesive as a wetting agent, but there was excessive flow into the slots during the pressure cure and a loss of strength of the bond. Various batches of Doryl from the two available sources were tried with varying results.

From these months of experimentation, best results were obtained when using production Doryl. Fewer bubbles resulted when the cure cycle started with a cold oven. Acceptable adhesion can be achieved only when the array sticks are post cured for three hours at 315°C. Since the solder sealing the module assembly ments at 310°C, the modules must be disassembled, bonded and reassembled.

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Rework of Antenna 3 was started. During this rework, it was found that the bubbles generated in the bonding operation could be reduced significantly by perforating a row of .030 diameter holes along each edge of the I8 fabric and in areas not covering the slots. Tests on 40 sticks indicate 75 per cent of the sticks have pressure losses within acceptable limits on the first bonding attempt. Those sticks out of tolerance have been reworked successfully by over-coating with I6 resin.

By the end of January, three modules of 16 sticks each have been dismantled, cleaned, vapor blasted, and ultra-sonically cleaned. Bonding is complete on two modules and their reassembly started.

H GROUND SUPPORT EQUIPMENT

At the completion of the recorder development, Itek supplied a rack used to test recorders. Changes were designed to allow this rack, when used with the standard test equipment, to perform the functional tests independent of the system on all radar system assemblies, except the transmitter and single axis platform and its electronics. A few power supplies, control circuits, and cables were required. Design of the changes are complete, and the actual modification approximately 85 per cent complete.

The recorder cart is complete and now in use with System 002 in the hangar.

A review of the Film Evaluator suggested several improvements in the azimuth evaluation portion to improve the usefulness in the examination of test targets. The following modifications were undertaken:

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(1) add micrometer to source slit to allow setting repeatability
(2) strengthen mechanically the track for the scanning slit
(3) modify projector section, using better lenses in an arrangement which allows easier and more stable alignment
(4) modify phototube circuitry to provide logarithmic display
(5) modify the light source to improve alignment and stability.

All the items have been completed, except (5).

The Radar Test Set has been used extensively to provide test signals to both the System in the F-101 and the back-up system. Particularly useful is the dual azimuth target simulation, as used in the tests to determine the effects of receiver non-linearities.

I SPARES

During this five month period, 68 items of system spares have been shipped, leaving 54 open items. Of 82 items added to spares list during this period 33 were transferred from the customer supplied list to be Westinghouse supplied and 11 were increased quantities.

Completion of spares work by amendment is as follows:

	Open Items	PerCent Complete
Basic list plus first 7 amendments	18	98.5%
Amendment 8	2	96 %
Amendment 9	13	56 %
Amendment 10	21	0 %

On the spares for Ground Support Equipment, 14 items were shipped during this period, no items were added, leaving 15 items remaining to be shipped. This amounts to 97% completion of the GSE spares.

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APPENDIX A
SUMMARY OF FLIGHTS

Flight Number	115	116	117
Date	9/14/64	9/16/64	9/23/64
Altitude	22,500	22,500	22,500
Area	Philadelphia, Pa.	Norfolk, Va.	Washington, D.C.
Purposes	System checkout and data acquisition.	Data acquisition and range boost tests.	Test range boost with 3 IF gains and linear motion compensation system.
Significant System Changes	30 V P-P limited video.	30 V P-P limited video.	
Results	Presentation good from 1/2 to 3/4 range. Resolution in best areas about 15 ft. in azimuth and 20 ft. in range. Clutter present on all strong targets. Images present on same. Contrast fairly good.	Presentation fair in best areas. Imaging and clutter detract significantly. Vegetation clutter extends into water. Contrast and resolution in best areas fair. No discernible effect of range boost. Focus poor over near range.	Presentation on a 50 sec. length of WF2 is fair. WF1 is too dense and lacks contrast. Imaging of a bridge is present. There was an apparent reduction of transmitter-receiver isolation during flight. Film failure during Run #2.

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Flight Number	118	119	120
Date	10/1/64	10/6/64	10/9/64
Altitude	22,500	22,500	45,000
Area	Washington, D.C.	Washington, D.C. & Baltimore, Md.	Philadelphia, Pa.
Purposes	Test range boost with 3 IF gains and linear motion compensation system.	Test range boost with 3 IF gains and linear motion compensation system.	Test linear motion compensation system and range boost 5.
Significant System Changes			12.5 V P-P video noise.
Results	Presentation is good from 1/2 to 3/4 range except some empty gaps in azimuth due to transmitter failure. 5 Volt signal level appeared better in contrast than 10 or 20 volt level. No discernible map differences in range boost changes.	Presentation is good from 1/3 to 3/4 range (on Run #1 at 10 volt level). Best azimuth resolution is approximately 15 ft. Low level contrast is good over best areas. Imaging and clutter is seen by strong targets as bridges, particularly from clocks 62 to 64. Good detail on most of map. No correlated film at 5 volt level. Transmitter failed during flight.	For about 8 clocks the presentation was fair over a strip from 1/2 to 3/4 range. During part of the flight transmitter was out of coincidence. 400 cps images were strong during this time.

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Flight Number	121	122	123
Date	10/13/64	10/16/64	10/21/64
Altitude	45,000	22,500	22,500
Area	Norfolk, Va.	Western Maryland	Bolling Field, Washington, D.C.
Purposes	Test range boost 5 with variable receiver gain.	Test range boost against corner reflectors.	Test range boost against corner reflectors.
Significant System Changes	Selected video noise levels of 20 V, 17 V, and 12 V.	Reduced recorder bias from 38 V to 30 V.	
Results	Map is fair for first 3-1/2 minutes over a strip from 1/2 to 3/4 range. Remainder of run has too low density and poor contrast. Imaging at 400 cps was strong. Even shore extends into water rather strongly.	Weather prevented flying by corner reflector area. Map is poor over the best regions. Contrast and density are too low. Over part of the film the density is so low that strong targets are hardly identifiable.	Map fair over strip from 1/2 to 3/4 range. Corner reflectors appeared on poor part of map on all runs. Azimuth resolution from detailed correlation of reflector areas was 3 to 4 ft. No range boost effects discernible.

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Flight Number	124	125	126
Date	10/28/64	11/4/64	11/10/64
Altitude	45,000	45,000	22,500
Area	Norfolk, Va.	Philadelphia, Pa.	
Purposes	Data acquisition with reflectors at Norfolk Airport.	Test new linear motion compensation system.	Test linear motion compensation system.
Significant System Changes	PFN change resulted in pulse width of 37 usec. and 29.5 watts power.	Minneapolis-Honeywell Integrator installed prior to flight.	
Results	Far range strip is good over most of the range. Contrast is fair. Near range is good from 1/3 to 3/4 range. Imaging at 400 cps not as strong as in some previous flights. Resolution in azimuth is approximately 25 ft.	On far range strip map is good from 1/3 to 7/8 range over most of the flight. On near range strip map was good from 1/2 to 2/3 range. Low level contrast is only fair. Imaging of bridges is quite noticeable at spacings of 400 cps and 120 to 150 cps. Compensating effect of accelerometer is not obvious.	Film jam in recorder prevented acquiring data.

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Flight Number	127	128	129
Date	11/13/64	11/17/64	11/17/64
Altitude	45,000	45,000	45,000
Area	Norfolk, Va.	Charleston, S.C.	Charleston, S.C.
Purposes	Test micro-megs parametric amplifier.	Data acquisition.	Data acquisition.
Significant System Changes	Parametric amplifier installed for this flight. Noise figure 5.6 from 6.3 db.	TDA re-installed prior to this flight. Noise figure 6.5 db.	
Results	Map was smeared in azimuth and contrast poor over whole flight. Flight was rough. Since accelerometer was not used in motion compensation, film was badly degraded.	Map out of focus entire flight. Inconsistent drift data from doppler navigator over smooth water causes doubt in ground speed data. Many blank spaces occurred because of DFT unlocking. Water was muddy. Resolution poor.	

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Flight Number	130	131	132
Date	11/20/64	11/24/64	12/7/64
Altitude	22,500	22,500	45,000
Area	Washington, D.C.	Washington, D.C.	Norfolk, Va.
Purposes	Test effects of IF limiting and IF gain.	Data acquisition and test integrator calibration.	High altitude test of integrator and data acquisition.
Significant System Changes	30 V P-P limited video; 5, 10, 15, & 20 db IF attenuation steps. Installed separate limiting IF for signal path. Recorder bias reduced to 25 V.	Auto-correlator installed for this flight.	Integrator re-calibrated prior to flight. Transmitter repair produced 58 watts pwr.
Results	Map is good over the range strip usually in focus for Runs #1 and #4. For attenuations of 10 db or more, the density level was too low and contrast was not as good as in the other runs.	First 22 clocks taken over rural area with only fair contrast and boundary resolution. Where aircraft was forced into sinusoidal motion, the map appeared good (azimuth resolution 20 ft. or less) when accelerometer was engaged. When accelerometer was disengaged, periodic smears were obvious. This effect was much greater on strong distinct targets than on vegetation areas.	Military operations over target area prevented supersonic flight. Integrator instrumentation run made at low altitude.

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Flight Number	133	134	135
Date	12/9/64	12/15/64	12/15/64
Altitude	45,000	45,000	45,000
Area	Philadelphia, Pa.	Charleston, S.C.	Charleston, S.C.
Purposes	Integrator test and data acquisition.	Data acquisition.	Data acquisition.
Significant System Changes		Increased CRT bias to 37.5 V with 25 V P-P limiting video. DFT gate at 235 usec.	
Results	General appearance of map was poor. Low level targets hardly discernible to clock #19. From clocks #25 to #30 astigmatism (or rotation) was bad and range resolution was poor. Cross track velocity was overcompensated.	Strong headwind kept ground speed 10% below nominal. Incorrect speed ratio caused map to be out of focus on entire flight. Results similar to flights 128-129, except signal level more consistent.	

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Flight Number	136	137	138
Date	12/31/64	1/6/65	1/6/65
Altitude	45,000	45,000	22,500
Area	Philadelphia, Pa.	Philadelphia, Pa.	Philadelphia, Pa.
Purposes	Data acquisition.	Reference for altitude comparison.	Run #1 - Simulated 45,000 flight flown at 22,500. Run #2 - Effect of 10 db S/N improvement.
Significant System Changes	Calibrated film speed prior to flight. Video limit level of 30 V P-P.	Recalibrated integrator for 5 V.G input. DFT gate at 235 usec.	Ferrite attenuator installed in receiver line, controlled from cockpit.
Results	Contrast was fair and resolution was between 20 and 30 ft. in best areas. From clocks #26 to #30 map faded because of extreme position of antenna due to accelerometer overcompensation and excessive ringing of accelerometer integrator. Strong targets were poorly resolved in this region.	Map improved in contrast and greater areas of well resolved targets. Some fading occurred between clocks #12 and #30 during which antenna was in extreme position. From clock #12 to #15 slope of accelerometer integrator output was excessive.	Map is best from 1/2 to extreme far range for Run #1. Contrast and resolution are good. Some fading from clock #35 to #40 when antenna was in extreme position. Some imaging and clutter of strong targets are noticeable on Run #2.

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Flight Number	139	140	141
Date	1/12/65	1/12/65	1/12/65
Altitude	45,000	45,000	22,500
Area	Charleston, S.C.	Charleston, S.C.	Targets of opportunity between Charleston & Baltimore.
Purposes	Data acquisition.	Data acquisition.	Data acquisition.
Significant System Changes	DFT gate set at 230 usec for this flight.	DFT gate set at 230 usec for this flight.	
Results	First correlations were out of focus, similar to flights 128-129 and 134-125. Recorrelated with a 20% shorter focal length gave very good map. No explanation for error; speed ratio checked within limits from films. Resolution about 15 ft. in azimuth and 20-25 ft. in range in last part of 140. Contrast is good over entire film. Occasional 400 cps and other images.		From clocks #15 to #20 map is good and resolution is good from 1/2 to 3/4 range. Average density is high and contrast is marginal in low level areas. Shore smeared into water at about 400 cps at clocks #24 and #44.

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Flight Number	142	143	144
Date	1/19/65	1/21/65	1/25/65
Altitude	45,000	45,000	45,000
Area	Philadelphia, Pa.	Philadelphia, Pa.	Philadelphia, Pa.
Purposes	Simulated 90,000 flight from 45,000.	Simulated 90,000 flight from 45,000.	Range boost test on 4 KC recorder (007).
Significant System Changes	Recorder 007 modified for 4 KC operation.	Replaced CRT bias pot and set for 60 V bias.	
Results	Defective CRT bias pot caused primary film density to be high. Best part of map is near mid-range. Average density is low, thus contrast is not adequate. Azimuth resolution is poor over most of the map.	Primary film density satisfactory. Best part of the map is from 1/4 range to mid-range due to filter slope mismatch. Map of small tanks at clock #27 is good. Tank size scales from 25 to 30 ft. on radar map compared to actual tank size of about 20 ft. Motion disturbances low here during this view time. Contrast is fair in tree-grass regions. Sidelobes or images appear at clock #32. Separation is 75 mils.	Map is best from 1/4 to 1/2 range. Azimuth resolution is below average over all the map. From clocks #10 to #15 some azimuth degradation occurs while integrator output slope is greater than 25 cps/sec. Contrast is fair for first 5 clocks and better during the remainder of the flight. Motion disturbances during the flight were significantly above average.

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